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THE DWARF FORESTS OF SOUTHERN CALIFORNIA

By ISAIAH BOWMAN

(Map facing p. 16.)

The terms "dwarf forest," "elfin-forest," and "chaparral" are used to designate a type of plant formation notable for its stunted trees with gnarled trunks and boughs. It is intermediate in character, as it is in position, between the formations of forest and desert. It is distinguished from the dwarfed forests of high altitudes (where the trees diminish in size and become procumbent on account of the cold) chiefly by a marked difference in the kinds of plants. Instead of having dwarfed specimens of trees from the neighboring forests, we have distinct genera. In California these are chiefly *Adenostoma, Arctostaphylos, Artemisia, Ceanothus, Eriodictyon, Quercus, Rhus, Ribes,* and *Yucca.* The total extent of true elfin forest is not large, and in the United States it is found only in southern California, where its influence on evaporation and water supply is so important that it has been the subject of special study by the Forest Service. The results are embodied in Bulletin 85, by F. G. Plummer, Geographer. This is the first publication dealing exclusively with chaparral, and since the conclusions are of great interest to geographers it seems desirable to present a brief account of them to a larger circle of readers.

From the profile of forest zones on the Pacific Coast (Fig. 1), it is seen that the range of the chaparral zone of California and Mexico is from 27° to 37° north latitude, and from sea level to 8,000 feet. Its most striking development is in the middle subzone, from 2,000 to 5,000 feet, where 95 out of 116 distinctive species grow. Of these 38 occur only in the middle subzone.

The restricted development of this forest type at once directs attention to the special climatic features of the region. Both Schimper and Warming explain the type by the highly restricted combination of a winter (low temperature) season with a marked though not abundant rainfall and a hot and nearly rainless summer. Thus in the northern part of the chaparral region of California only about 3 per cent. of the scanty rainfall occurs in the summer season and in the central and southern parts less than 1 per cent. A second feature is the orientation of the main range, the Sierra Madre (a group name which includes the San Gabriel, San Bernardino and

San Raphael Ranges), which trends eastward from the coast, or *down* the westerly winds. The rain-bearing winds pass freely through the low passes on either side and are not forced over the mountains to any considerable degree. The result is a drier mountain climate than in the Sierra Nevada on the north or the San Jacinto on the south. It is therefore in the Sierra Madre that the chaparral has its best development.

In the chaparral area the wet-winter and dry-summer climate reverses the ordinary habits of plants. The distinctive species make most of their growth in winter and are then green, in contrast to their brown, lifeless summer appearance. The distribution of the rainfall varies with the altitude, increasing at the rate of 0.6 inch for each 100 feet of rise. Along the coast the mean annual rainfall is thirteen inches, insufficient to support even a dwarf forest except for scattered tracts of oak woodland. At 2,000 feet the dwarf forest begins in its most characteristic phases and at 8,000 feet is displaced by the normal forest of the belt of high precipitations.

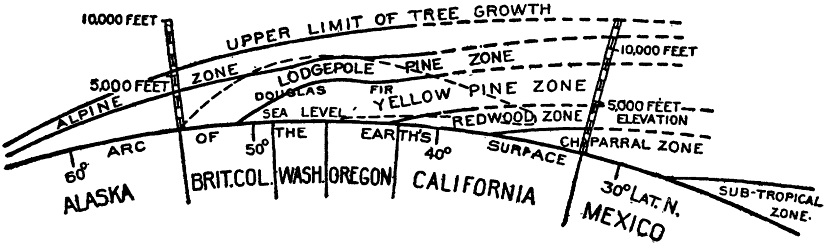


Fig. 1—Forest zones of the Pacific Slope. (Reproduced from Fig. 1, Bull. 85, U. S. Forest Service.)

The dependence of the mild climate upon the westerly ocean winds is strikingly brought out when, at long intervals, the hot northern or eastern desert wind—the so-called "Santa Ana"—reaches the coast, or when the southern storms, or "Sonoras," begin to blow. The high mountains near the low-latitude coast bring about a well-nigh tropical compression of climatic belts. "One may, sandaled and hatless, pick an orange or a fig while gazing at snow-capped hills" (p. 14). The sea fauna is likewise varied and includes both the Behring seal and whale and tropic goldfish and sea turtles.

Throughout dry southern California water is of the utmost importance for irrigation and municipal supplies. In fact the future population of the region will be limited only by the amount of water which can be made available. It is in its relation to the water-supply that chaparral is chiefly important. It conserves the moisture and regulates the flow of the streams (1) through its roots which assist percolation and prevent erosion, and (2) through a reduction of the rate of evaporation by breaking the force of the hot winds and by shading the ground. These beneficial effects have not been quantitatively determined, but their truth has been established by the well-known effects of grazing, burning, and clearing, upon both springs and streams.

The density and composition of the chaparral vary with the elevation. In the Pasadena watershed 84 per cent. of the surface is shaded on the northern slopes between 2,000 and 3,000 feet, while only 57 per cent. is shaded at the same elevation on the southern slopes. The corresponding figures for the Santa Ana watershed are 64 per cent. and 39 per cent. Between 3,000 and 5,000 feet the percentages are about equal in both cases. It is well known that the San Bernardino Range is a fault block with steep bordering escarpments and a rather smooth summit. An examination of the detailed tables on pages 27-28 of Bulletin 85 appear to show that the chaparral growth is distinctly thinner on the bordering dissected scarps than on the smoother upper or lower slopes. The contrast in density between northern and southern slopes is explained by the

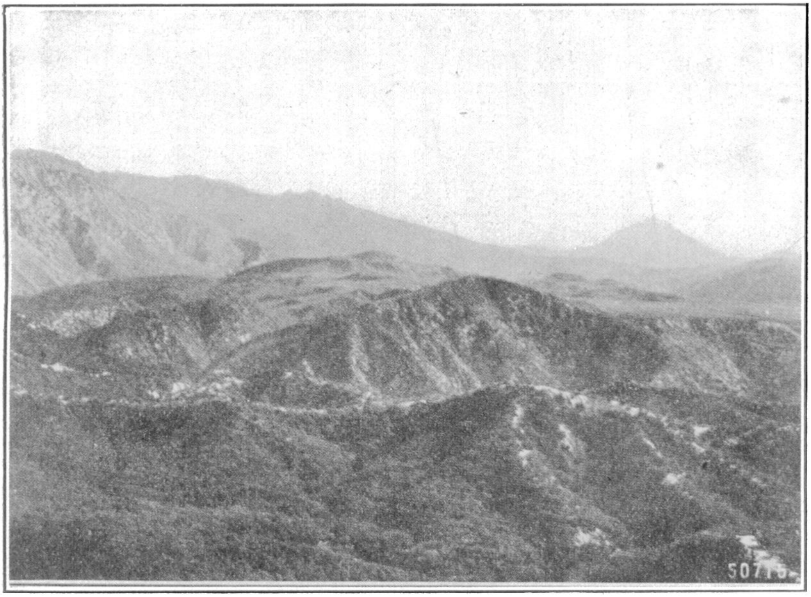
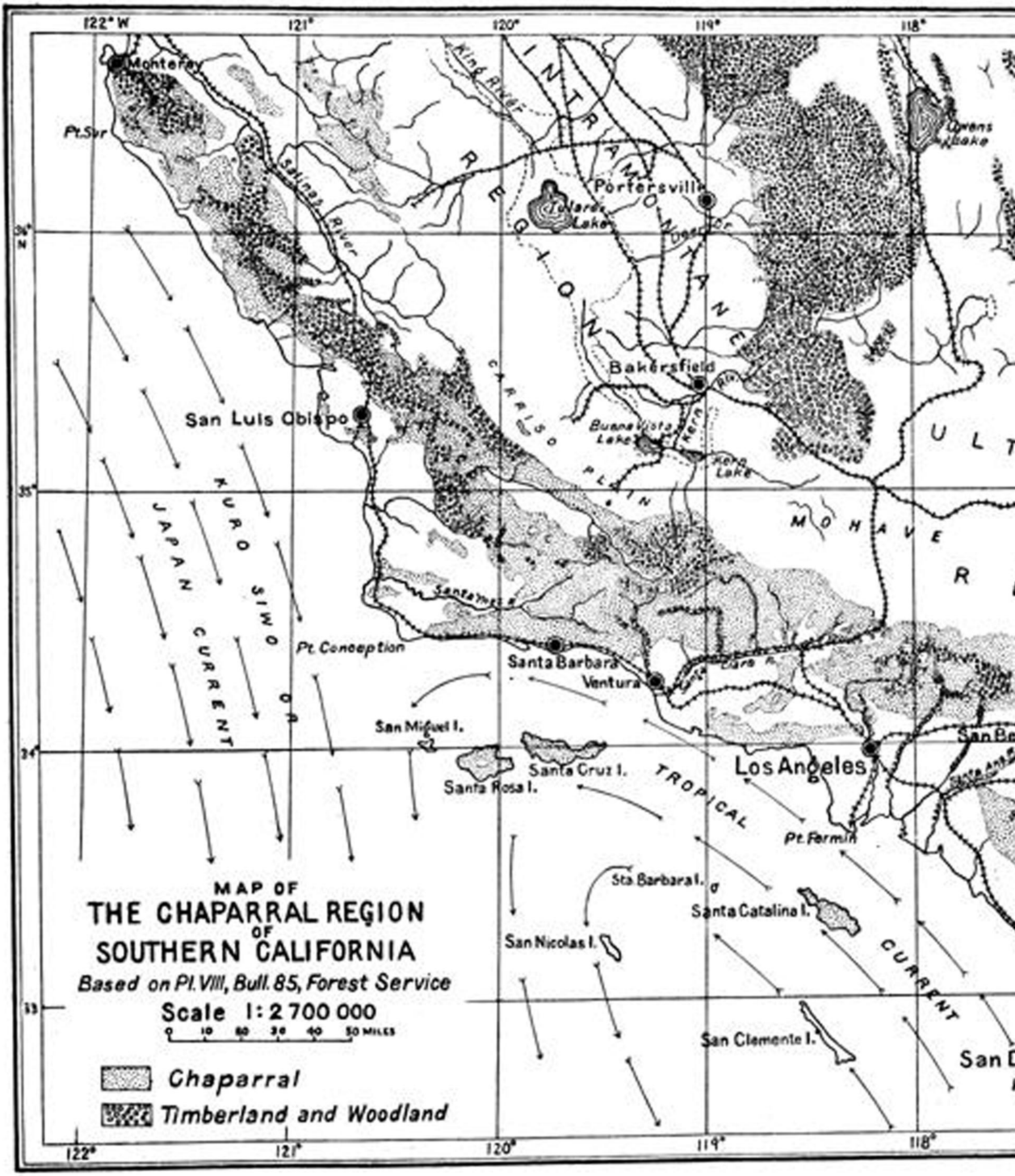


FIG. 2—Northern end of Santa Ana Mountains showing good cover of old chaparral undamaged by fire. (Reproduced from Fig. 1, Pl. v, Bull. 85, U. S. Forest Service.)

contrast in temperatures and its effect on reproduction. Fire is about the only agency which tends to limit the density of the chaparral in protected situations. In northerly slopes fires do little permanent damage; the chaparral soon regains possession. On southerly slopes the soil is drier, the growth is poor and scattered, and the fire-baked ground is inhospitable to the forest pioneers.

The limited commercial use of chaparral is the natural result of its dwarfed and twisted growth. During the early settlement of southern California, and before coal and lumber were imported, it furnished a part of the fuel supply. In recent years the demand from this source has practically ceased. Some species are used for fencing, and the Indians at one time gathered the nuts of others for food. A few species have medicinal value. In time of drought cattle browse on chaparral; sheep can do fairly well, but their wool prevents them from penetrating the denser stands; while goats thrive on it. It was the custom in the early days for the cattlemen to set fire to the chaparral in the belief that it would make way ultimately for better forage; prospectors burned over the areas they were about to explore, and hunters drove out game by the same means. These practices have virtually ceased with better laws based on larger experience and the necessity for carefully conserving the water supply. Bee culture is an established industry in the chaparral area, since there is scarcely a time of year when at least some species do not furnish the necessary supplies. About 700 tons of honey are produced annually.

It is concluded that the present distribution of normal forest and chaparral represent a natural balance between two contesting plant formations. It follows that the restocking of burned or cleared areas in the chaparral zone with native forest species of economic value would be attended with very limited success. Among exotic species, better adapted to the soil and the climate and at the same time affording adequate cover and commercial timber, the most promising are the eucalypts of Australia and Tasmania. About 100 species are now grown in various parts of California, Arizona, Texas, and New Mexico, but none can endure very cold weather, the extremes for the hardiest species ranging from 10° to 18° F. It is estimated that about 1,000,000 acres of the chaparral area would support a growth of the most desirable species of eucalypts and that on another 1,000,000 acres more hardy but less valuable species could be grown. It is doubted, however, if the expense of such planting should be entailed until a larger number of species and habitats have been tested experimentally.



MAP OF
THE CHAPARRAL REGION
OF
SOUTHERN CALIFORNIA
Based on Pl. VIII, Bull. 85, Forest Service
Scale 1:2 700 000

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